Family 47. **Gelechiidæ.**

Genus 103. Exodomorpha, Walker.

137. *Exodomorpha divisella*, Walker.

Natal (eight examples).

Family 48. **Pterophoridæ.**

Genus 104. Agdistes, Hübner.

138. *Agdistes pustulalis*, Walker.

Natal.

There are also in the Collection two species of Tortricites and two Tineites which I have been unable to determine; and as at present I do not possess sufficient knowledge of the groups to refer them to their proper positions, I cannot attempt to name them. I have to thank Mr. F. Moore, of the Indian Museum, for very kindly assisting me in determining some of the more obscure genera of Pyralites and Geometrites.

LVI.—*Relation of the Canal-System to the Tubulation in the Foraminifera, with reference to Dr. Dawson's 'Dawn of Life.'* By H. J. Carter, F.R.S. &c.

As an illustration of the relation of the canal-system to the tubulation in Foraminifera in the so-called "*Eozoon canadense*," Dr. Dawson repeats, in his book just published (the 'Dawn of Life'), p. 43, a fac-simile of the woodcut which illustrates his letter in 'Nature' (vol. x. p. 103, June 1874), which illustration had been previously published in the 'Annals & Mag. Nat. Hist.' (vol. xiii. pl. xix. fig. 1, June 1874), and also appeared about the same time in the 'Monthly Microscopical Journal.'

By this I infer that the woodcut (which, in the 'Dawn of Life,' is stated to be "after Carpenter") is the most convincing representation that Dr. Dawson can adduce of the identity of Foraminiferal structure with that of the so-called "*Eozoon canadense*" in the Laurentian limestone; for we find in the 'Dawn of Life,' p. 204, the following paragraph:—

"In the 'Annals of Natural History' for June 1874, Dr. Carpenter has given a crushing reply to some objections raised in that Journal by Mr. Carter. He first shows, contrary to the statement of Mr. Carter, that the fine nummuline tubulation corresponds precisely in its direction with reference to

the chambers with that observed in *Nummulites* and *Orbitoides*. In the second place, he shows by clear descriptions and figures that the relation of the canal-system to the fine tubulation is precisely that which he had demonstrated in more recent nummuline and rotaline Foraminifera. In the third place, he adduces additional facts to show that in some specimens of *Eozoon* the calcareous skeleton has been filled with calcite before the introduction of any foreign mineral matter. He concludes the argument in the following words :—'I have thus shown,'" &c. (See the rest in Dr. Dawson's book, and in the 'Annals,' *l. c.* vol. xiii. p. 463.)

Now I do not hesitate to state that the woodcut to which I have alluded, and which is one of the "clear figures" to which Dr. Dawson alludes, does *not* show "that the relation of the canal-system to the fine tubulation is precisely that which he [Dr. Carpenter] had demonstrated in more recent nummuline and rotaline Foraminifera,"—inasmuch as it is impossible to demonstrate that which is utterly at variance with the principle on which a Foraminiferous test is constructed.

This is a decided expression; but having published nearly as much of the anatomy of the Foraminifera in 1852 ('Annals,' vol. x. p. 161, pl. iv.) and, subsequently, in a more general form, in 1861 (*ibid.* vol. viii. p. 309 *et seq.* pls. xv., xvi., xvii.) as I have of the Spongida during the present year, and having now before me perhaps one of the finest collections of Operculine, Nummuline, and Acervuline Foraminifera that exist, both fossil and recent, simple and infiltrated (that is, with the original cavities of the canal-system, tubulation, and chambers filled with red oxide of iron to the minutest degree), together with a knowledge of the active living animal in a recent state gained here on the sea-side, and the typical piece of the so-called "*Eozoon canadense*" submitted by Dr. Carpenter to Professors King and Rowney for conviction, I claim to have a voice in the matter, and to be allowed to state instructively what the *real* relation of the canal-system is to the so-called "nummuline tubulation" in the Foraminiferal test.

For this, then, I must premise (what, I fear, judging from that which others have published on the subject, is so little understood generally) :—First, that in the ammonite-like form of *Operculina*, where the chambers are only one deep and therefore all the chambers on the same plane, the tubuli of the chambers (that is, the "nummuline tubulation") go straight from the roof of the chamber to the surface of the *Operculina*, thereby affording not only the shortest but the most direct communication with the exterior that the sarcode and its contents, with which the chamber is exclusively filled, can obtain;

while the canal-system is entirely outside the tubuli and the chamber with which they are connected. Thus the flat surface of the vertically compressed chamber on either side of the *Operculina*, as its ammonite-like form lies horizontally on the table, is vertically pierced by the tubuli; while the narrow part or vertical sides of the compressed chamber, which is concealed within the test, is pierced *alone* by the ramuli coming off from the large branches of the canal-system which border upon the chamber all round.

Secondly, that as the single plane of chambers of *Operculina* is multiplied vertically in the Nummulite, the same structure, *mutatis mutandis*, is here repeated, while the tubuli go from chamber to chamber; and nothing interferes with this arrangement in the whole pile of chambers until the tubuli thus, at last, open on the surface.

The reason of this is obvious; for the tubuli transmit the sarcode from the chamber, which appears to be successively engaged in forming the layers of the test, while there are no tubuli in the contracted sides of the chamber, which, being covered by the surface-layer of the test, do not need them, but instead are pierced by the ramuli of the canal-system, which thus communicate with the interior of the chamber.

The function of the canal-system has not yet been discovered; but the main canals, which border the contracted sides of the chamber (viz. that part of it within the test) all round, send off three sets of branches, viz.:—1st, those which penetrate the "contracted sides" of the chamber; 2nd, those which open on the surface of the *smooth* areæ of the test surrounding the chamber; and, 3rd, those which open on the convex surface of the marginal cord. The latter I have been able to show distinctly in a preparation lately made of a portion of the marginal cord of *Nummulites lævigatus*, where, as in *Operculina*, their apertures appear like *puncta* scattered over the convex surface of the cord along the lines of the amorphous matter which fills up the interstices between the hard crystalline, fusiform, spicule-like bodies that not only form the surface of the cord here, as in *Operculina*, but, in some specimens of *Operculina*, are continued inwards *over* the intercameral spaces to the preceding turn of the spire, showing that Dr. Carpenter is quite wrong when he states that this structure "is due to the peculiar manner in which the homogeneous substance of which it [the marginal cord] is composed is traversed by the 'marginal plexus'" ('Introduction to Study of Foraminifera,' p. 257, 1862)—since there is no "plexus" here, any more than in the marginal cord in direct contact with the spicular structure, simply because the latter is on the *surface* of the test,

where *alone* the "puncta" (which are the openings of the ramuli of the large canals forming the plexus) are present and visible.

With reference to the function of the sarcode of the chamber, all that can be stated at present is that, being for the most part filled with bodies like ova, it is analogous to an ovisac, and thus apparently designed chiefly for the purpose of reproduction.

Thirdly, as regards the Acervuline forms of Foraminifera, in which the chambers are heaped up upon one another as the bulk of the mass increases, although this does not take place with such regularity as in Nummulites, it will be seen that the principle of structure *must* be the same from the simplest to the most complicated form of Foraminiferal tests: viz. the tubuli must be more or less perpendicular to the walls of the chamber; and therefore, as the lines of the chambers are necessarily continuous from the centre to the circumference, the canal-system *cannot interrupt, but must be wholly outside them.*

Thus it follows that the canal-system can *never* be *opposite the ends of the tubuli*; for *no* portion of it can ever be *within* the chambers, where *alone* the ends of the tubuli present themselves, till the latter reach the surface. Yet, on the other hand, the canals may run directly parallel to or across the long diameter of the tubuli at any angle; but it *must* be *outside* them. *No* section could ever bring them *opposite the ends* of the tubuli, if they are not *in* the chamber.

Now let us look at the woodcut to which I have referred, and there we shall find the fragments of the so-called "canal-system" (*b b*) cut across *opposite* the ends of the tubuli, showing that they are on the same plane, whereby they must have been *in* the chamber, which, as I have shown, is an impossibility in Foraminiferal structure.

I therefore most unhesitatingly state that there is no identity between this *selected* representation of the so-called "*Eozoon canadense*" and Foraminiferal structure. Such a relation of "canal-system" to "nummuline tubulation" could not exist in a Foraminiferal test either in theory or fact!

Since, then, Dr. Dawson could not see this, I am not surprised that he should have stated that Dr. Carpenter had "given a crushing reply" to my objections; while the amount of knowledge of Foraminiferal structure, both recent and fossil, that is displayed in other parts of his book may suit popular taste, but can hardly call for scientific reply.

This, however, is the age of wild speculation, and that which is most sensational (alas for Science!) is also most attractive. It puts one in mind of the Hindoo, who considers the simple truths

of Christianity not worth his notice; but tell him there is a ladder between the highest summit of the Himalaya and the Heavens, on which there are Munis and Rishis going up and down all the day long, and he will say "that's *worth* believing!" Belonging to that school which can see nothing satisfactory in a theory so elastic that no human argument can cover it, and nothing so contemptible, in a scientific point of view, as the habit of hastily theorizing, I have not much sympathy with those who are always ready with a cause and explanation for every thing. When facts are discovered, they can be told in a few words; and the most palpable only should be credited with a deduction like that of the "dawn of life."

LVII.—*Contributions to the Study of the chief Generic Types of the Palæozoic Corals.* By James Thomson, F.G.S., and H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E., Professor of Natural History in the University of St. Andrews.

[Continued from p. 309.]

[Plate XII.]

Genus Amplexus.

Amplexus, Sowerby, Mineral Conchology, vol. i. p. 165.

Gen. char. Corallum simple, subcylindrical or cylindro-conical, tapering towards the base, frequently tall, and more or less twisted. The epitheca is thin, with encircling lines of growth; and accretion-ridges are usually more or less conspicuously developed. Septa delicate and very short, never reaching to near the centre of the calice. Tabulæ exceedingly well developed, extending completely across the visceral chamber, and invariably exposed over a wide central area, into which the septa do not penetrate. A septal fossula is present, which is usually formed by a slight lateral depression of the tabulæ. Calice circular, moderately deep, with a thin margin.

The nearest ally of *Amplexus* has generally been assumed to be *Zaphrentis*; and there is doubtless a close alliance between the two. Typical examples of the former, however, are very readily and completely separated from characteristic species of the latter genus by the much more rudimentary condition of the septa and the nature of the septal fossula.